

REMARKS

Applicants respectfully request entry of the amendment and reconsideration of the claims. Claims 3, 7, 13, 14, 17, 19, and 20 have been amended. Claim 24 is newly presented. Claims 4 and 5 have been incorporated into claim 19. After entry of the amendment, claims 3 and 7-24 will be pending. Claims 15, 16, and 18 have been withdrawn by the Examiner as being directed to a non-elected invention.

Applicants submit the amendment is supported throughout the specification, including for example at page 9, line 14 to page 10, line 4, page 15, lines 7-8 and Fig. 2, and does not introduce new matter.

35 U.S.C. § 112

Claim 7 was rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Applicants have amended claim 7 to clarify the ranges recited in the claim. The amendment is supported by the specification, for example, at page 10, line 9 of the specification. Withdrawal of the rejection is respectfully requested.

35 U.S.C. § 102

Claims 1, 3, and 17 were rejected under 35 U.S.C. § 102(e) as being anticipated by Ohzu (U.S. 6,416,898). Without acquiescing to the rejection and solely for the purpose of expediting prosecution, claim 1 has been canceled without prejudice or disclaimer and claims 3 and 17 have been amended to depend from independent claim 19, which was not subject to the present rejection. The rejection is therefore moot in view of the amendment and withdrawal of the rejection is respectfully requested.

35 U.S.C. § 103

1. Claim 13 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu. Without acquiescing to the rejection and solely for the purpose of expediting prosecution, claim 13 has been amended to depend from independent claim 19, which was not subject to the present

rejection. Applicants, however, note that claim 19 was rejected under § 103(a) over Ohzu in view of Debe (U.S. 5,879,828) and further in view of Morosanu ("Thin Films by Chemical Vapor Deposition", Elsevier, Amsterdam, 1990, pp. 42-43) as discussed below. Applicants therefore address the rejection insofar as the rejection may apply to claim 13 as presently amended.

The Office Action at page 3 alleges Ohzu teaches that the thickness of the inorganic film is 1 to 70% of the thickness of the organic compound film which is in the range of 5-150 μm and that 50% of 100 μm would result in a thickness of 50 nm. Applicants note that the calculation in the Office Action is incorrect and that 50% of 100 μm is 50 μm , not 50 nm. The glass film disclosed in Ohzu has a thickness of about 30 microns (Ohzu at Example 1) or a thickness of about 20 microns (Ohzu at Examples 2 and 3) which is approximately 60-30,000 times thicker than that of the present invention. Ohzu therefore does not teach or suggest the range of thickness recited in claim 13. Withdrawal of the rejection is respectfully requested.

2. Claim 14 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu in view of Zuber (U.S. 6,156,449). Applicants traverse the rejection. Without acquiescing to the rejection and solely for the purpose of expediting prosecution, claim 14 has been amended to depend from independent claim 19, which was not subject to the present rejection. The rejection is therefore moot in view of the amendment and withdrawal of the rejection is respectfully requested.

3. Claim 19 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu in view of Debe (U.S. 5,879,828) and further in view of Morosanu ("Thin Films by Chemical Vapor Deposition", Elsevier, Amsterdam, 1990, pp. 42-43). Applicants respectfully traverse this rejection.

Without acquiescing to the rejection and solely for the purpose of advancing prosecution, claim 19 has been amended to recite one or more organic metal compound reactants in conjunction with one or more gases selected from the group consisting of nitrogen, hydrogen, steam, and argon. Applicants reserve the right to pursue the cancelled subject matter in a

continuation application. The combination of references does not teach or suggest manufacturing composite membranes by PECVD using one or more of the recited organic metal compound reactants in combination with nitrogen gas, hydrogen gas, steam, argon gas, or a combination thereof.

The Office Action alleges Ohzu teaches composite membranes for a fuel cell comprising an inorganic thin film as recited in the claims but does not teach plasma enhanced chemical vapor deposition (PECVD) of the polymer electrolyte membranes with the thin inorganic film. The Office Action alleges it would have been obvious to one of skill in the art to utilize a plasma CVD process for depositing oxide films on a membrane as disclosed by Debe and Morosau to deposit the oxide films in the process disclosed by Ohzu. Applicants respectfully do not agree.

It is improper to combine references where the references teach away from their combination. MPEP § 2145(X)(D)(2) citing *In re Grasselli*, 713 F.2d 731, 743 (Fed. Cir. 1983). It is well established that "a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention." MPEP § 2141.02 citing *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540 (Fed. Cir. 1983) *cert. denied*, 469 U.S. 851 (1984). If a proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. MPEP § 2144(VI) citing *In re Ratti*, 270 F.2d 810 (CCPA 1959).

The physical properties regarding pore size and thickness of the glass film disclosed in Ohzu are different from that of the claims. Ohzu clearly discloses that the inorganic glass is made by a sol gel method. See for example Ohzu at column 4, lines 66-67 and Examples 1-9. The sol-gel method disclosed in Ohzu provides porous inorganic glass and is therefore distinctive from the PECVD method and the reactive sputtering methods recited in the claims which provide non-porous inorganic glass. A film manufactured by PECVD is not porous and has a highly crosslinked and tight structure, a good mechanical property, superior insolubility and thermal stability. Further, a film manufactured by PECVD is superior in its adhesive strength (see the specification at page 15, lines 8-12).

Ohzu discloses that the loss of water from the organic compound film and the permeation of methanol through the same organic compound film can be effectively suppressed by providing very fine pores on the surface of the inorganic glass film facing the fuel electrode (Ohzu at column 7, lines 61-66); that the porous inorganic glass film provides a fuel system that does not require an attachment for keeping the moisture of the electrolyte membrane, which has been indispensable for conventional electrolyte membrane, and can be made more compact (Ohzu at column 8, lines 10-13); and that methanol permeation is suppressed and fuel efficiently utilized by disposing a specific inorganic glass having very fine pores on the surface of a proton-conducting organic compound film facing the electrode (Ohzu at column 8, lines 23-28). Thus, one of skill in the art would not have been motivated to utilize the plasma CVD process disclosed in Debe or Morosanu to deposit the oxide films in Ohzu's process because substituting non-porous inorganic thin films for the porous inorganic thin films disclosed in Ohzu would change the principle of operation of the fuel cell disclosed by Ohzu which specifically requires porous inorganic thin films.

Moreover, the glass film disclosed in Ohzu has a thickness of about 30 microns (Ohzu at Example 1) or a thickness of about 20 microns (Ohzu at Examples 2 and 3) which is approximately 60-30,000 times thicker than that of the present invention. Therefore, the manufacturing steps recited in the claims impart distinctive structural characteristics with respect to physical structure, porosity, and thickness of the composite membranes.

Applicants submit an electrolyte membrane comprising a laminate comprising a first film made of a proton-conducting organic compound and a second film made of a proton-conducting inorganic glass cannot be achieved by the methods disclosed in Ohzu.

Ohzu discloses the following method for making inorganic glass:

A glass substrate was immersed in the mixed metal alcoholate solution, and the solution was hydrolyzed by adding HCl (or ammonia) as a hydrolysis catalyst at room temperature to form a gel film on the glass substrate. The glass substrate was subsequently taken out from the solution and dried, thereby forming a dry gel film having a thickness of about 30 μm on the glass substrate. The resultant dry gel film was heat-treated at a temperature of about 700° C. for 5 hours in air, thus forming a proton-conducting $\text{P}_2\text{O}_5\text{-SiO}_2\text{-TiO}_2$ inorganic glass film. Measurements of pore size distribution showed that the pore size of the glass film was distributed

below 1000 nm with a peak at 500 nm. Then the inorganic glass film was laminated on a surface of the solid polymer membrane which was to face a fuel electrode, thereby obtaining an electrolyte membrane.

Ohzu at column 13, lines 1-17 (emphasis added)

Applicants submit that if the gel film on the glass substrate were heat-treated at a very high temperature of 700° C, it is likely that the gel film will adhere to the glass substrate such that it is difficult to separate the gel film from the glass substrate. Consequently, Applicants believe that the lamination of the gel film on the surface of the polymer membrane cannot be achieved. Even if the gel film disclosed in Ohzu could be laminated on the solid polymer membrane, the structure of the gel film would be so ruined that the pore size and the pore rate of the inorganic glass would be significantly modified. Therefore, an electrolyte membrane comprising a laminate consisting of a first film made of a proton-conducting organic compound and a second film made of a proton-conducting inorganic glass cannot be achieved based on the detailed description of Ohzu.

In view of the forgoing, Applicants submit that the Office Action has failed to make the required *prima facie* case of obviousness as the cited references, either alone or in combination, do not disclose or suggest all the claim limitations and lack sufficient reason to combine. Withdrawal of the rejection is respectfully requested.

4. Claims 4, 5, 8, and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu in view of Debe and Morosanu and further in view of Kwok (U.S. 5,271,972). Applicants respectfully traverse this rejection.

The Office Action at page 5 acknowledges that the combination of Ohzu, Debe and Morosanu fails to teach a metalloorganic compound and oxygen as a reactant. Kwok allegedly discloses a method for depositing a silicon dioxide film by reacting TEOS and oxygen and that it would be obvious for one of skill in the art to combine the Kwok, Ohzu, Debe and Morosanu to arrive at the claims. Applicants respectfully do not agree.

Claims 4 and 5 have been incorporated into claim 19. The combination of Ohzu, Debe and Morosanu fails to disclose or suggest the claims for the reasons discussed above. Kwok fails to cure the deficiencies of the combination of Ohzu, Debe and Morosanu. Claim 19 as amended does not recite TEOS or oxygen and Kwok does not teach or suggest a method for manufacturing

composite membranes by using PECVD method, which utilizes trimethyl disiloxanes (TMDSO), hexamethyl disiloxane (HMDSO), hexamethyl disilane tetramethyl orthosilicate, tetrabutyl orthosilicate, tetra-isopropyl orthosilicate, aluminium methoxide, aluminium ethoxide, aluminium butoxide, aluminium isopropoxide, titanium ethoxide, titanium methoxide, titanium butoxide, titanium isopropoxide, zirconium ethoxide, and zirconium butoxide as reactants, in conjunction with one or more gases selected from the group consisting of nitrogen, hydrogen, steam, and argon.

In view of the foregoing, Applicants submit that the Office Action has failed to make the required *prima facie case* of obviousness as the cited references, either alone or in combination, do not disclose or suggest all the claim limitations and lack sufficient reason to combine. Withdrawal of the rejection is respectfully requested.

5. Claims 10-12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu in view of Debe and Morosanu and further in view of Kwok and Izu (U.S. 5,670,224). Applicants respectfully traverse this rejection.

The combination of Ohzu, Debe, Morosanu, and Kwok does not disclose or suggest all the elements of the claims for the reasons discussed above. Izu does not remedy the shortcomings of the combination of Ohzu, Debe, Morosanu, and Kwok as Izu does not teach or suggest a method for manufacturing composite membranes by using PECVD method, which utilizes trimethyl disiloxanes (TMDSO), hexamethyl disiloxane (HMDSO), hexamethyl disilane tetramethyl orthosilicate, tetrabutyl orthosilicate, tetra-isopropyl orthosilicate, aluminium methoxide, aluminium ethoxide, aluminium butoxide, aluminium isopropoxide, titanium ethoxide, titanium methoxide, titanium butoxide, titanium isopropoxide, zirconium ethoxide, and zirconium butoxide as reactants, in conjunction with one or more gases selected from the group consisting of nitrogen, hydrogen, steam, and argon.

In view of the foregoing, Applicants submit that the Office Action has failed to make the required *prima facie case* of obviousness as the cited references, either alone or in combination, do not teach or suggest all the claim limitations and lack sufficient reason to combine. Withdrawal of the rejection is respectfully requested.

6. Claims 7 and 20-22 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu in view of Sproul (U.S. 5,789,071). Applicants respectfully traverse this rejection.

Without acquiescing to the rejection and solely for the purpose of advancing prosecution, titanium oxide (TiO_2), zirconium oxide (ZrO_2), and aluminum oxide (Al_2O_3) have been removed from claim 20. Neither Sproul nor Ohzu teach or suggest a method for manufacturing composite membranes by using reactive sputtering method, which uses one or more selected from the group consisting of silicon oxide (SiO_2), zirconium phosphate ($\text{Zr}(\text{HPO}_4)_2$), zeolite, and silicalite as an inorganic material of the inorganic thin film.

Moreover, Ohzu teaches away from non-porous inorganic thin films for the reasons discussed above. Therefore, one of skill in the art would not have been motivated to utilize the sputtering process disclosed in Sproul to deposit the oxide films in Ohzu's process because substituting non-porous inorganic thin films for the porous inorganic thin films disclosed in Ohzu would change the principle of operation of the fuel cell disclosed by Ohzu which specifically requires porous inorganic thin films.

In view of the foregoing, Applicants submit that the Office Action has failed to make the required *prima facie* case of obviousness as the cited references, either alone or in combination, do not teach or suggest all the claim limitations and lack sufficient reason to combine. Withdrawal of the rejection is respectfully requested.

7. Claim 23 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohzu in view of Sproul and further in view of Izu. Applicants respectfully traverse this rejection.

The combination of Ohzu and Sproul does not disclose or suggest all the elements of the claims for the reasons discussed above. Izu does not remedy the shortcomings of the combination of Ohzu and Sproul as Izu does not teach or suggest a method for manufacturing composite membranes by using reactive sputtering method, which uses one or more selected from the group consisting of silicon oxide (SiO_2), zirconium phosphate ($\text{Zr}(\text{HPO}_4)_2$), zeolite, and silicalite as an inorganic material of the inorganic thin film.

In view of the foregoing, Applicants submit that the Office Action has failed to make the required *prima facie* case of obviousness as the cited references, either alone or in combination,

do not teach or suggest all the claim limitations and lack sufficient reason to combine.

Withdrawal of the rejection is respectfully requested.


Summary

In view of the above amendments and remarks, Applicants respectfully request a Notice of Allowance. If the Examiner believes a telephone conference would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

Respectfully submitted,

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